22-32 PARK AVENUE WAITARA

Natural Ventilation Assessment

Prepared for:

Statewide Planning Pty Ltd
L1, 31 Cowper Street
PARRAMATTA NSW 2150

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Statewide Planning Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.19164-R01-v1.3	19 October 2021	Peter Hayman	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
610.19164-R01-v1.2	26 March 2021	Peter Hayman	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
610.19164-R01-v1.1	16 March 2021	Peter Hayman	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
610.19164-R01-v1.0	15 January 2020	Peter Hayman	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy

EXECUTIVE SUMMARY

SLR Consulting Pty Ltd (SLR) has been engaged by Statewide Planning Pty Ltd to assess the natural ventilation of the proposed residential development at 22-32 Park Avenue, Waitara.

The State Environmental Planning Policy (SEPP) 65 supported by the Australian Design Guide is relevant to the assessment of the natural ventilation through residential components of proposed development. Section 4B-3 of the Australian Design Guide states that:

At least 60% of apartments are naturally cross ventilated in the first nine storeys of the building. Apartments at ten storeys or greater are deemed to be cross ventilated only if any enclosure of the balconies at these levels allows adequate natural ventilation and cannot be fully enclosed.

The proposed development implements a number of the ADG recommendations to maximize the natural cross ventilation throughout the development.

- The proposed development has been provided with openings on multiple sides of the apartments for the majority of proposed floor plans, allowing it to make use of wind-induced natural ventilation throughout the year and thereby minimising energy costs.
- In general the overall depth of cross-over or cross-through units does not exceed 18 m as per the Design Criteria of Objective 4B-3.

Natural cross ventilation to many single aspect apartments is achieved via building indentations. This is anticipated within ADG Section 4B which states in its opening paragraph that "*Natural cross ventilation is achieved by apartments having more than one aspect with direct exposure to the prevailing winds, **or** windows located in significant different pressure regions, rather than relying on purely wind driven air*".

- SLR has identified further apartments that could potentially achieve natural cross ventilation through utilising building slots, recesses and high windows. These were analysed using Computational Fluid Dynamics (CFD) numerical modelling.

The following conclusions have been reached based on a qualitative review of the floorplans of the ADG complaint dual aspect units and quantitative numerical modelling of non-dual aspect units:

- Building A: 69.2% (27 out of 39) of the apartments will be naturally cross ventilated, thereby meeting the ADG requirements.
- Building B: 65.1% (28 out of 43) of the apartments will be naturally cross ventilated, thereby meeting the ADG requirements.
- Building C: 75.0% (18 out of 24) of the apartments will be naturally cross ventilated, thereby meeting the ADG requirements.
- Building D: 78.9% (30 out of 38) of the apartments will be naturally cross ventilated, thereby meeting the ADG requirements.
- Building E: 75.0% (18 out of 24) of the apartments will be naturally cross ventilated, thereby meeting the ADG requirements.

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FIGURES

APPENDICES

1 Introduction

SLR Consulting Pty Ltd (SLR) has been engaged by Statewide Planning Pty Ltd to assess the natural ventilation of the proposed residential development at 22-32 Park Avenue, Waitara. This assessment forms part of the Development Application to the Hornsby Shire Council. This will be done through the combination of a qualitative review of the floor plans and 3D models provided and a quantitative Computational Fluid Dynamics (CFD) assessment of selected apartments.

1.1 Site and Surrounds

The proposed site is located to the north west of Sydney near the corners of Richmond Road and Garfield Road West. The surrounds of the site are predominantly open currently with there being some residential housing approximately 700m metres to the north west.

Figure 1 Site Location

Image: Nearmap (2 November 2019)

1.2 Development Description

The proposed development covers five buildings across the site. Each building consists of six storeys in height and there are two basement car parking levels. The apartment breakdown is as follows:

- Building A – 39 apartments.
- Building B – 43 apartments.
- Building C – 24 apartments.
- Building D – 35 apartments.
- Building E – 24 apartments.

For a total of 165 apartments.

2 Australian Design Guide Requirements

The State Environmental Planning Policy (SEPP) 65 supported by the Australian Design Guide is relevant to the assessment of the natural ventilation through residential components of proposed development. Section 4B-3 of the Australian Design Guide states that:

At least 60% of apartments are naturally cross ventilated in the first nine storeys of the building. Apartments at ten storeys or greater are deemed to be cross ventilated only if any enclosure of the balconies at these levels allows adequate natural ventilation and cannot be fully enclosed.

The following points from the design guide are also noted.

- Overall depth of a cross-over or cross-through apartment does not exceed 18m, measured glass line to glass line.
- Natural ventilation to single aspect apartments is achieved with a light well or stack effect ventilation (or similar) or courtyards or building indentations have a width to depth ratio of 2:1 or 3:1 to ensure effective air circulation and avoid trapped smells.
- In cross-through apartments external window and door opening sizes/areas on one side of an apartment (inlet side) are approximately equal to the external window and door opening sizes/areas on the other side of the apartment (outlet side).

There are no specific requirements (eg air changes per hour) in the ADG guideline.

AS1668.2-2002 “The use of ventilation and airconditioning in buildings Part 2: Ventilation design for indoor air contaminant control (excluding requirements for the health aspects of tobacco smoke exposure)” recommends 3 air changes per hour for habitable rooms to satisfy the air quality requirements.

3 Natural Ventilation

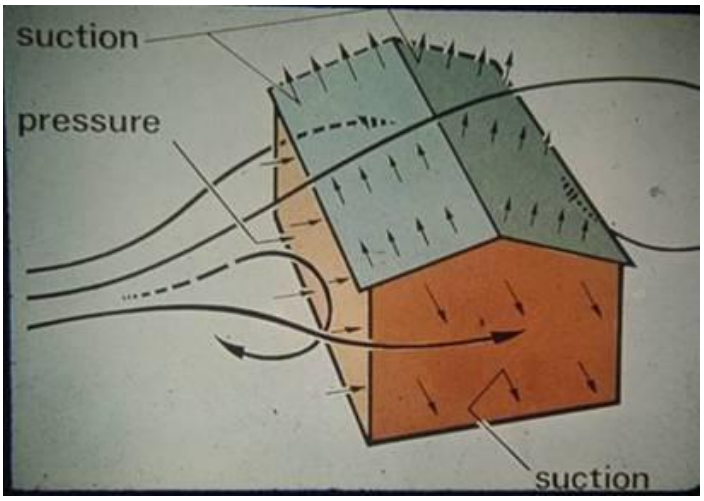
3.1 General Principles

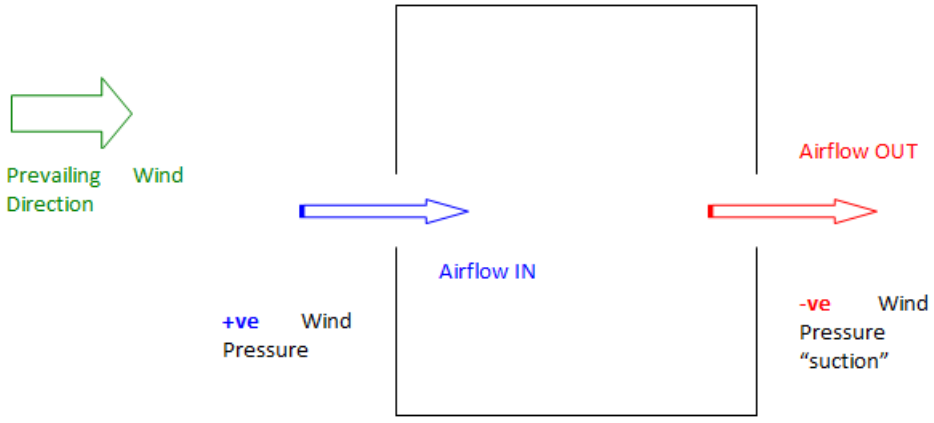
A key feature of the proposed development is the incorporation of façade openings designed to enable various spaces within the development buildings to make use of wind–induced natural ventilation throughout the year thereby minimising energy costs.

Wind-induced natural ventilation works on the straightforward principle of differential pressure. If a building envelope has multiple openings and there exists a pressure difference between those openings, e.g. the wind pressure at one opening is greater than the pressure at the other opening; airflow will be pushed through the building in the direction positive to negative.

The resulting amount of airflow through the building envelope will be a function of the magnitude of the pressure differential, size of the various building openings and degree of "blockage" in between. These features are illustrated in Figure 2**.**

Figure 2 Wind-Induced Natural Ventilation via Differential Pressure





4 Qualitative Assessment

The natural ventilation for the proposed residential development has been qualitatively assessed. Ventilation is achieved by the differential pressure between the different building facades.

For the qualitative assessment SLR used Revision C of the plans dated 12th February 2021.

4.1 Qualitative Results – Dual Aspect Apartment

Table 1 Cross Ventilated Apartments – Building A

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage
1	8	4	50.0%
2	8	6	75.0%
3	8	6	75.0%
4	8	6	75.0%
5 & 6	7	5	71.4%
Total	39	27	69.2%

Table 2 Cross Ventilated Apartments – Building B

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage
1	9	4	44.4%
2	9	6	66.7%
3	9	6	66.7%
4	9	6	66.7%
5 & 6	7	5	71.4%
Total	43	27	62.8%

Table 3 Cross Ventilated Apartments – Building C

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage
1	4	2	50.0%
2	5	4	80.0%
3	5	4	80.0%
4	5	4	80.0%
5 & 6	5	4	80.0%
Total	24	18	75.0%

Table 4 Cross Ventilated Apartments – Building D

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage
1	8	4	50.0%
2	7	4	57.1%
3	7	4	57.1%
4	7	4	57.1%
5 & 6	6	6	100.0%
Total	35	22	62.8%

Table 5 Cross Ventilated Apartments – Building E

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage
1	4	2	50.0%
2	5	4	80.0%
3	5	4	80.0%
4	5	4	80.0%
5 & 6	5	4	80.0%
Total	24	18	75.0%

5 Quantitative CFD Assessment

Recesses and articulations create pressure and velocity differences across the various facades and encourage cross ventilation through an increased number of apartments. From experience SLR has found that numerical solutions including Computational Fluid Dynamics (CFD) and wind tunnel studies can prove these apartments to provide appropriate through apartment ventilation and circulation, for natural ventilation requirements.

SLR has assessed the apartments that connect to the "slots" of each building the locations of which are shown in Figure 3. Some deeply recessed apartments have also been modelled

Figure 3 Examples of Slots and Recesses (Level 2)

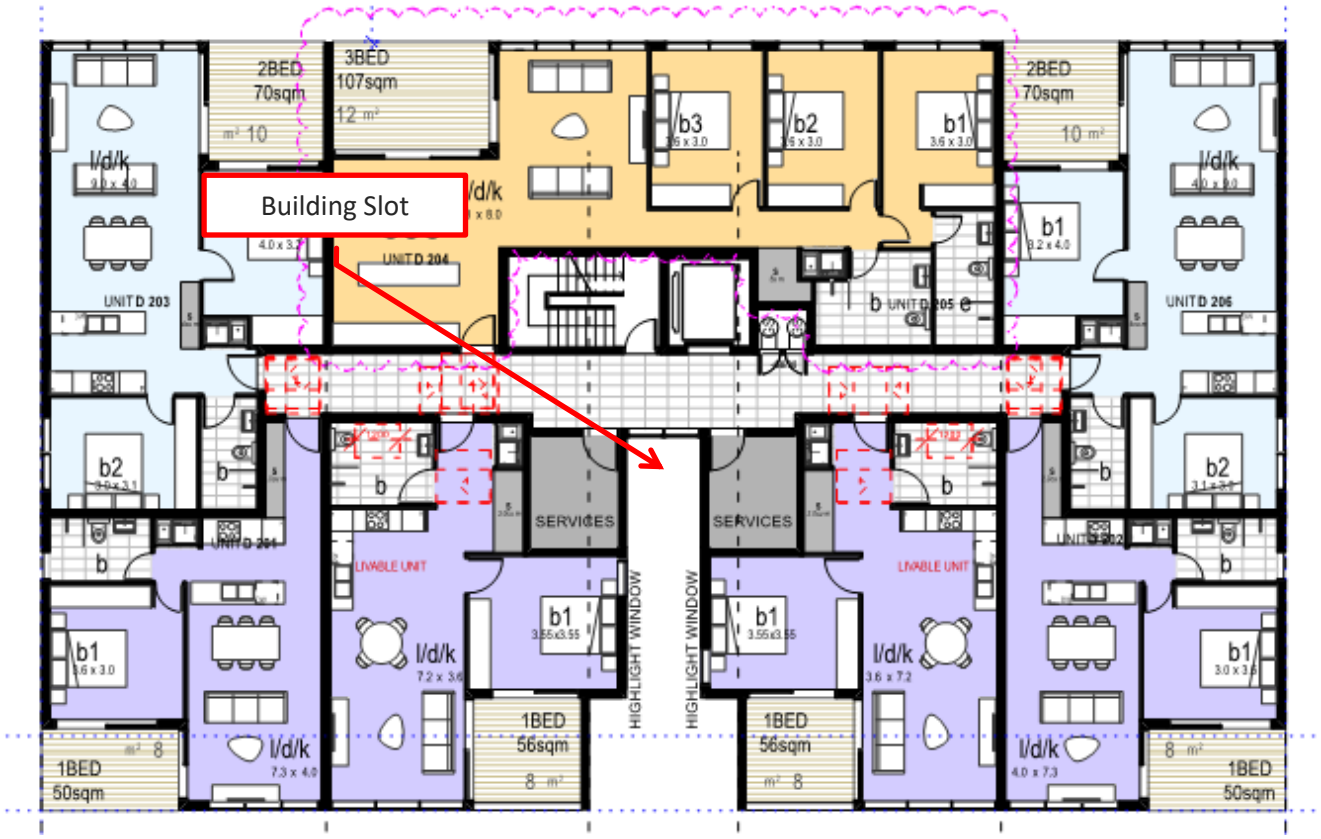
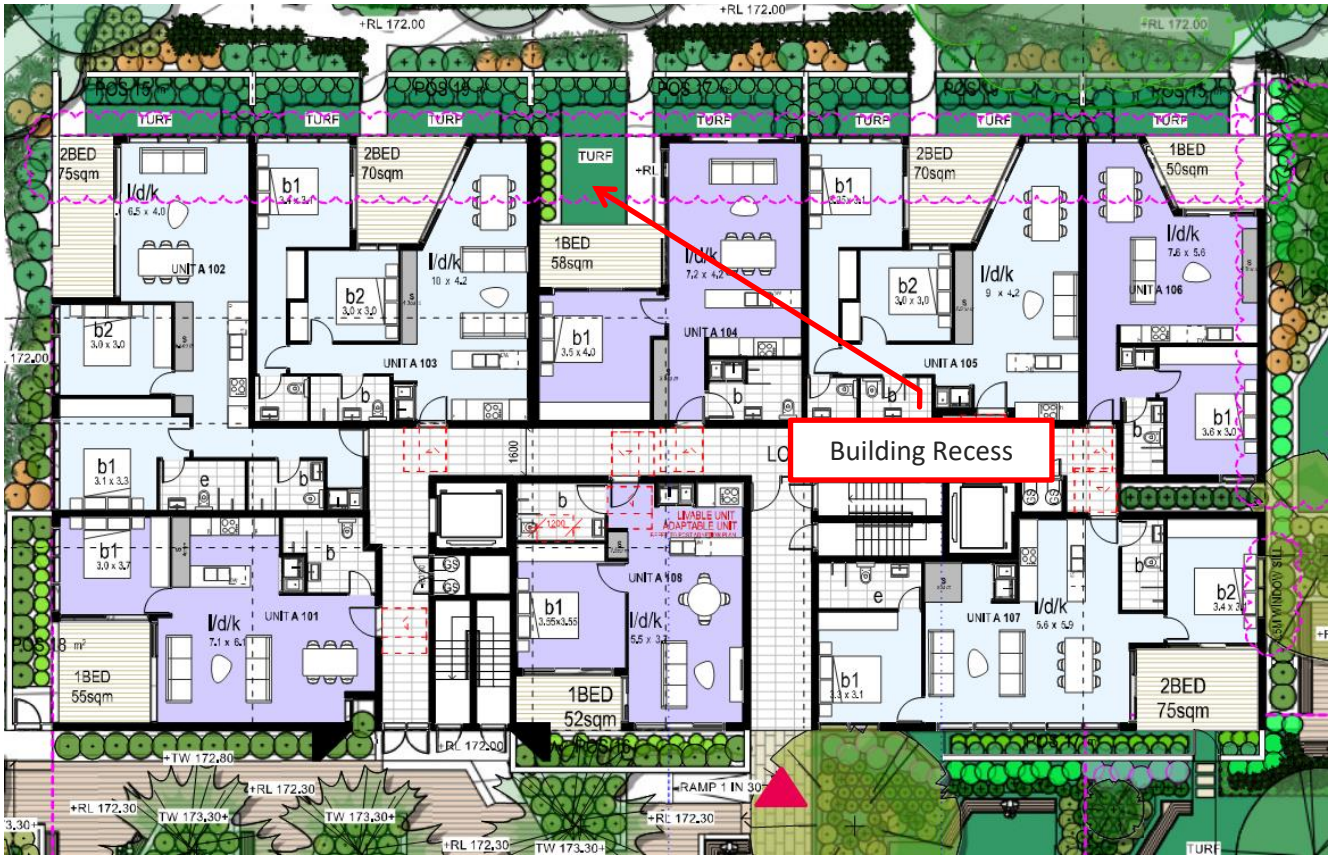


Figure 4 Examples of Slots and Recesses (Level 1)



A detailed computer model of the development was created based on the Architectural Drawings and CAD models supplied in December 2019. Apartments on the Level 1, Level 2 and Level 4 were included for detailed numerical assessment. The Computational Fluid Dynamics (CFD) specialised software FLUENT was used to model the following wind directions.

- North
- North east
- South east
- South
- South West
- West

In each case a gentle wind speed of 1.66 m/s was used at 10 m high.

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations in Australia. The closest such station to the Development Site is the Terrey Hills Automatic Weather Station (AWS), which are located approximately 10.5 km northeast of the Development Site. Based on actual wind data across 5 years (2014 to 2018), the average wind speed measured at the nearby Terry Hills weather station is 2.7 m/s. The numerical modelling results in this study are therefore conservative and the cross ventilation will increase with increasing approaching wind speeds.

- In summer, wind speeds ranged from calm to moderate (between 0 m/s and 8 m/s). The majority of winds blew from the northeast and east-northeast directions, with fewer winds from north, east and south directions. Very few winds were observed to be blowing from the west. Calm wind conditions were recorded approximately 2.8% of the time during summer.
- In autumn, wind speeds ranged from calm to moderate (between 0 m/s and 8 m/s). The majority of winds blew from the west, northwest and east-southeast directions, with fewer winds from between the north to east and southeast to west-southwest directions. Calm wind conditions were recorded approximately 1.4% of the time during autumn.
- In winter, wind speeds ranged from calm to moderate winds (between 0 m/s and 7.6 m/s). The majority of winds blew from west and west-northwest directions, with fewer winds from between the northwest to north and south to west-southwest directions. Very few winds were observed to be blowing from the east. Calm wind conditions were recorded approximately 1.4% of the time during winter.
- In spring, wind speeds ranged from calm to fresh winds (between 0 m/s and 9.6 m/s). The majority of winds blew from the north and northeast directions, with fewer winds blowing from the east-northeast to north-northwest directions. Calm wind conditions were recorded approximately 2.5% of the time during spring.

Simple blocks were used for nearby surrounding buildings to include the impact of the surroundings on the natural ventilation for the proposed building. All velocities in the images are in metres per second and the simulation results are presented at a typical chest height of 1.5 metres above the floor level. This height is indicative only to show the flow around the apartment. SLR uses the modelled speeds to check there is at least three air changes per hour for each apartment. The figure below shows the flow patterns for an example apartment at varying heights.

5.1 CFD Results

SLR deems an apartment to have adequate natural ventilation if it shows reasonable airflow for four of the six wind directions tested. Reasonable flow means the apartment has airflow of at least three air changes per hour (at least 0.1 m/s through some areas) and shows good flow from room to room without short circuiting.

The Revision C plans were found to be similar enough to the modelled design that the results can be applied to the current plans.

The CFD results are detailed in **Appendix A** and summarised in the following tables.

Table 6 Building A

Apartment	North Winds	North East wind	South East wind	South Wind	South West Wind	West Wind	Overall Result
A104	6.2	1.7	17.4	0.2	3.6	2.6	**FAIL**

Table 7 Building B

Apartment	North Winds	North East wind	South East wind	South Wind	South West Wind	West Wind	Overall Result
B104	3.8	0.7	5.7	4.8	3.1	3.1	PASS

Table 8 Building D

Apartment	North Winds	North East wind	South East wind	South Wind	South West Wind	West Wind	Overall Result
D205	1.2	6.4	5.4	6.4	9.6	8.6	PASS
D207	5.9	3.5	3.5	5.2	5.4	4.9	PASS
D405	1.0	9.9	4.4	5.2	5.2	1.0	PASS
D407	4.9	4.7	3.7	4.4	5.4	8.4	PASS

6 Overall Natural Ventilation Results

SLR modelled apartments on Level 1, Level 2 and Level 4 to gain an understanding of apartments across all similar levels.

Apartments on other levels are expected to perform in a similar manner to the nearest modelled apartment (assumptions have been made conservatively).

The overall results are summarised in the tables below.

Table 9 Apartments with Openings to Support Natural Ventilation – Building A

Level	Number of Apartments	No. Apartments Cross Ventilated (Qualitative)	Additional Apartments from Building slots (CFD Modelling)	Combined Total	Combined Total (%)
1	8	4	0	3	50.0%
2	8	6	0	5	75.0%
3	8	6	0	5	75.0%
4	8	6	0	5	75.0%
5 & 6	7	5	0	5	71.4%
Total	39	27	0	23	69.2%

Table 10 Apartments with Openings to Support Natural Ventilation – Building B

Level	Number of Apartments	No. Apartments Cross Ventilated (Qualitative)	Additional Apartments from Building slots (CFD)	Combined Total	Combined Total (%)
1	9	4	1	5	55.6%

Level	Number of Apartments	No. Apartments Cross Ventilated (Qualitative)	Additional Apartments from Building slots (CFD)	Combined Total	Combined Total (%)
2	9	6	0	6	66.7%
3	9	6	0	6	66.7%
4	9	6	0	6	66.7%
5 & 6	7	5	0	5	85.7%
Total	43	27	1	28	65.1%

Table 11 Apartments with Openings to Support Natural Ventilation – Building D

Level	Number of Apartments	No. Apartments Cross Ventilated (Qualitative)	Additional Apartments from Building slots (CFD)	Combined Total	Combined Total (%)
1	8	4	2	6	75.0%
2	8	4	2	6	75.0%
3	8	4	2	6	75.0%
4	8	4	2	6	75.0%
5 & 6	6	6	0	6	100.0%
Total	38	22	8	30	78.9%

7 Conclusion

SLR Consulting Pty Ltd (SLR) has been engaged by Statewide Planning Pty Ltd to assess the natural ventilation of the proposed residential development at 22-32 Park Avenue, Waitara.

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Natural cross ventilation to many single aspect apartments is achieved via building indentations. This is anticipated within ADG Section 4B which states in its opening paragraph that "*Natural cross ventilation is achieved by apartments having more than one aspect with direct exposure to the prevailing winds, **or** windows located in significant different pressure regions, rather than relying on purely wind driven air*".

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The following conclusions have been reached based on a qualitative review of the floorplans of the ADG complaint dual aspect units and quantitative numerical modelling of non-dual aspect units:

- Building A: 69.2% (27 out of 39) of the apartments will be naturally cross ventilated, recommendations have been given to meet the ADG.
- Building B: 65.1% (28 out of 43) of the apartments will be naturally cross ventilated, thereby meeting the ADG requirements.
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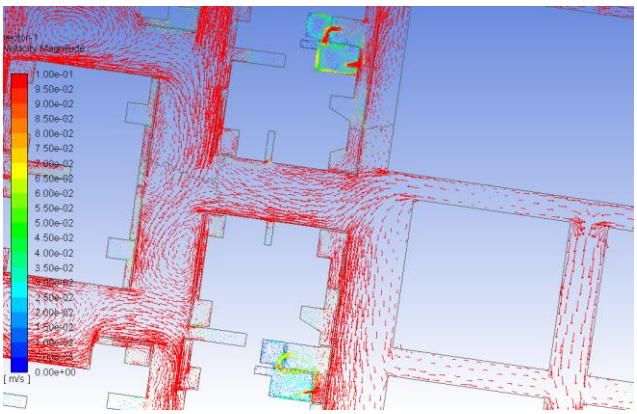
APPENDIX A

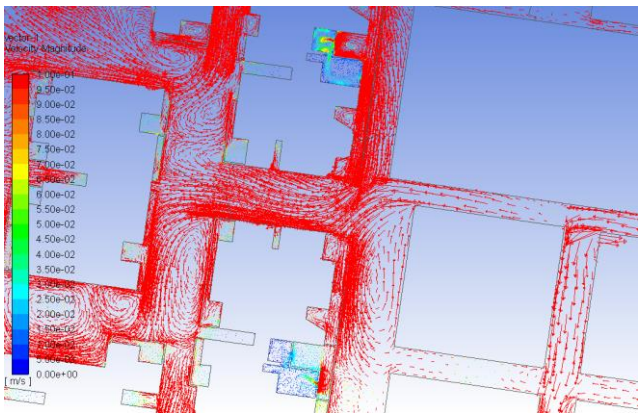
Vector Flow Diagrams

Red areas indicates speeds at or above 0.1 m/s

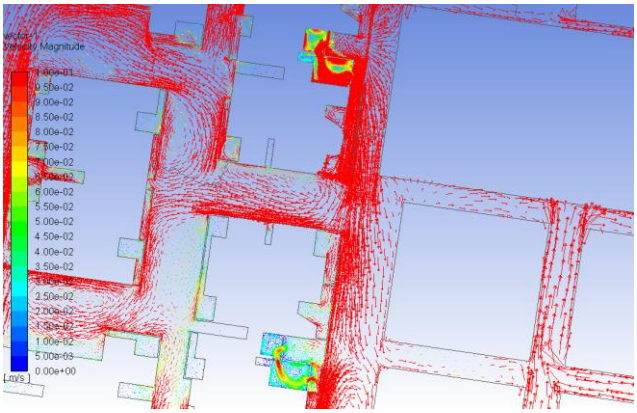
Building A & B – Level 1



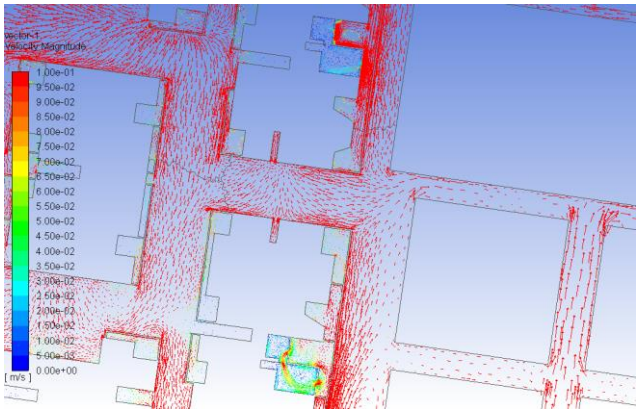
North



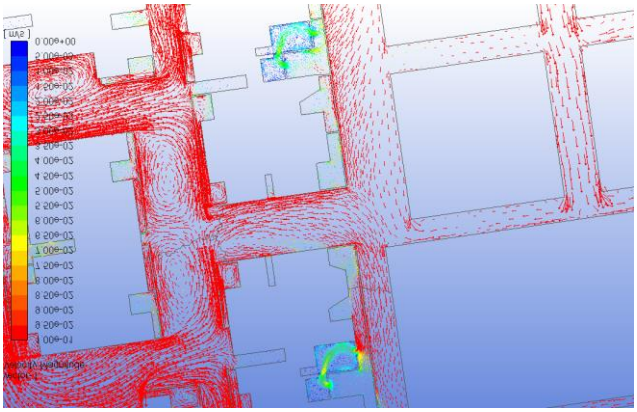
North East



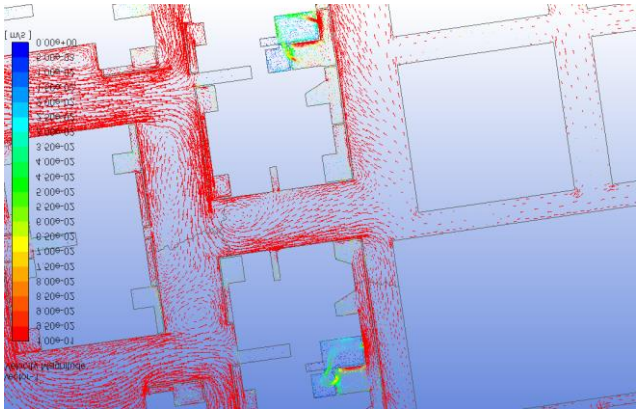
South East



South

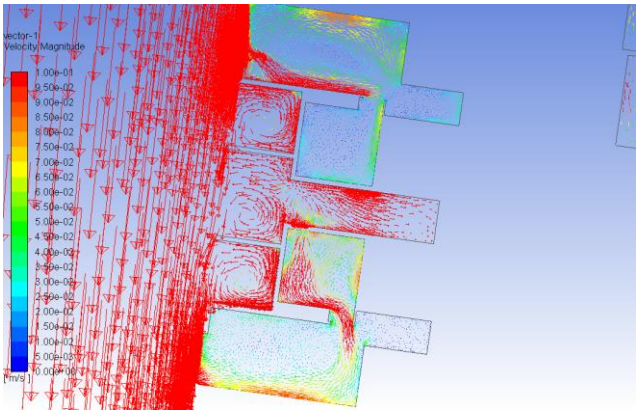


South West



West

Building D – Level 2



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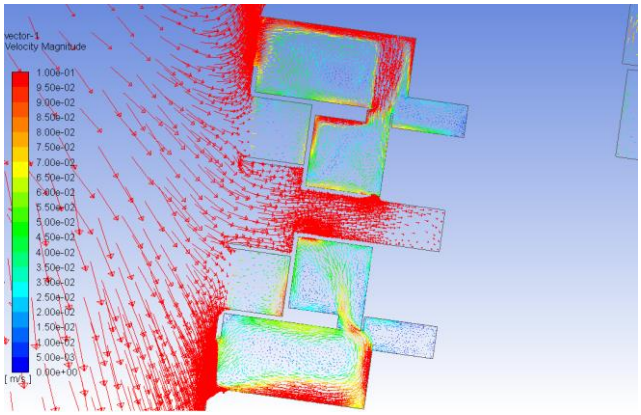

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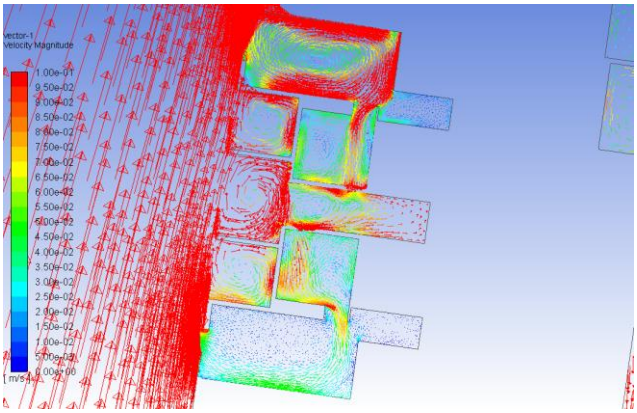

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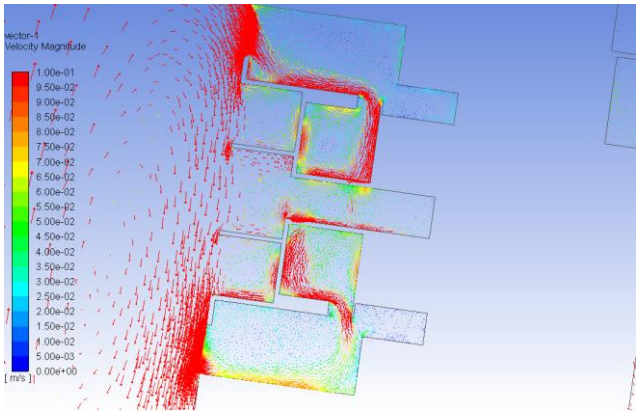

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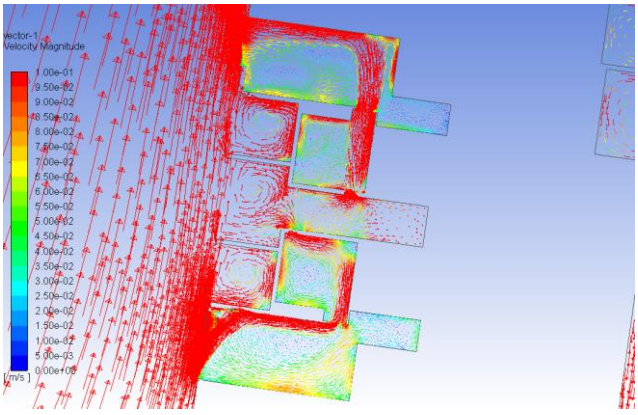

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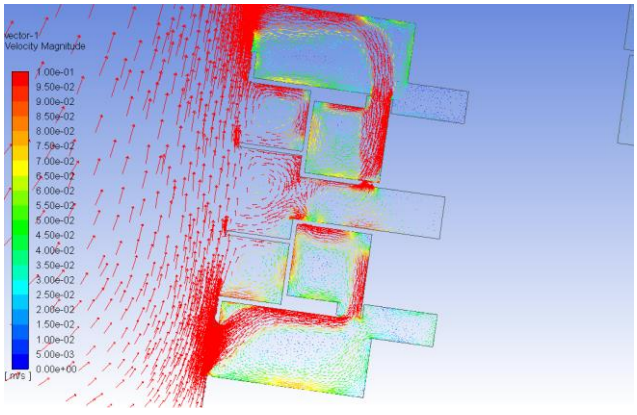
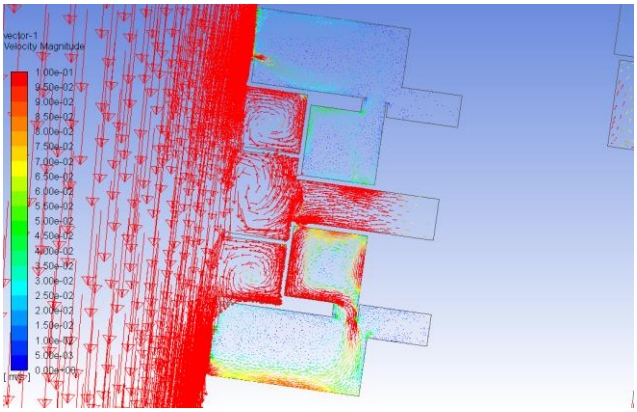
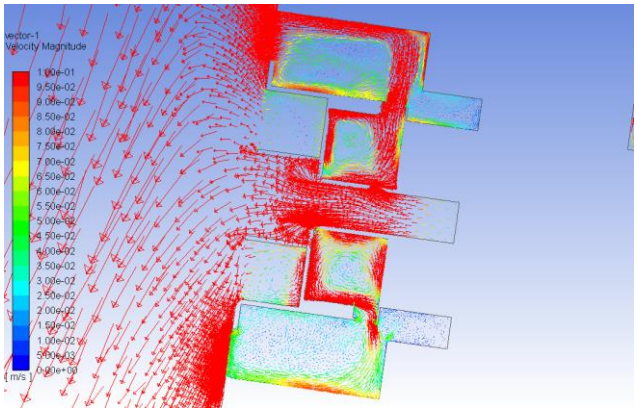


West

Building D – Level 4



North



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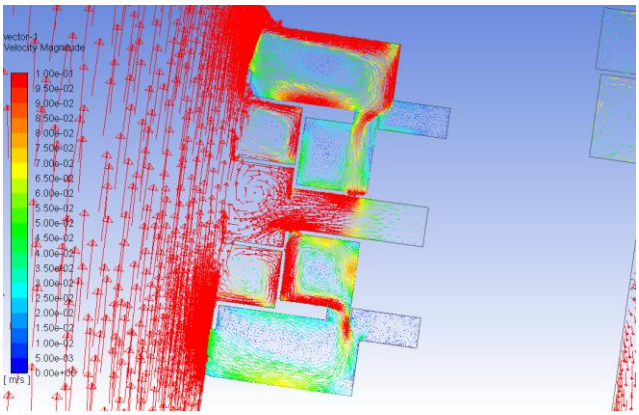

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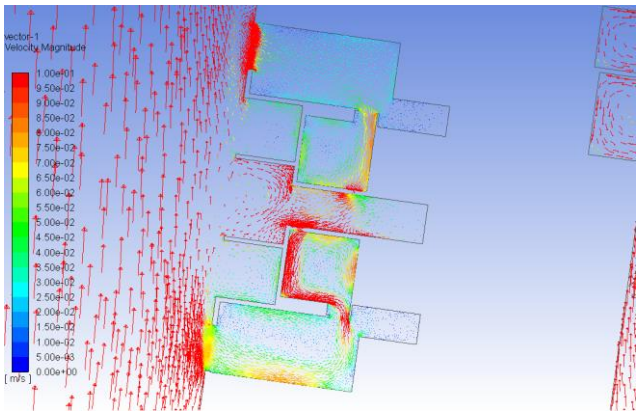
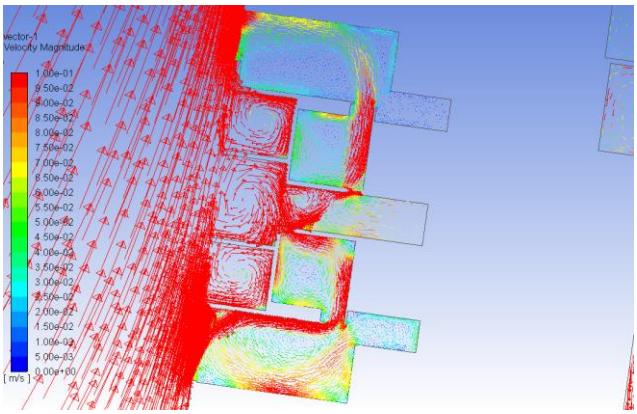
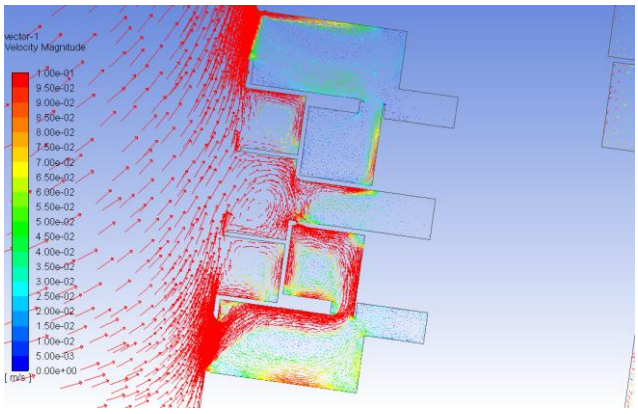


South



South West



West

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